Space Weather Technical Forecast

Issued on Monday, 10 October 2022 at 13:42 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: Chance of M-class flares. Active electron Fluence.

Analysis of Space Weather Activity over past 24 hours
Solar Activity: Solar activity has been Low to Moderate over the past 24 hours, with recorded X-ray activity confined to C and M-class at GOES16 and 17. The largest flare of the period was a longer period M1.1 at 10/0046UTC. Also of note was a slowly rising and falling C3.9 at 09/1427UTC, with both of these emanating from the largest and nominally most complex region on the disc, AR3112, which is currently a Fhi/Beta-Gamma-Delta. This type of slow-burn flare has been typical of this sunspot group in recent days, with its apparent complexity not yet borne out in activity.
There are five numbered sunspot groups on the disc. AR3112 remains the largest and most complex group, with a delta spot fading from its leader spot but forming within the intermediate area, therefore classification remains similar for now. To its north, AR3116 continued to see small changes to its trailing portion. AR3118 saw minor growth and a small delta spot looks to have formed between the two main spots as the total area increased slightly. Other spots showed little change.
Around 09/2300 UTC a filament eruption was seen from the southeast quadrant, this has been analysed as having the potential for an Earth directed component and we await model data for assessment. Finally, during the early hours a dimming was detected in AIA211 in the central southwestern quadrant, possibly related to a filament lift off. Imagery remains inconclusive as to if any CME has resulted or if the filament was re-absorbed, but this will be monitored.

Solar Wind / Geomagnetic Activity: The solar wind, as measured by DSCOVR and ACE at L1 was generally Elevated to Strong under HSS influences, with a rising trend being evident until around the middle of the period followed by a slow decline with values reducing to Slightly Elevated at times by the end of the period. The phi angle was mostly positive (away from the Sun), but with small period of negative after 09/2230UTC. The solar wind speed was around 570km/s to start the period, with brief peaks 630km/s overnight before an easing back to current level, around 530km/s. The solar wind density was slightly above average. The IMF was within its typical weak background range, with a peak near 6nT. The north-south component was small-scale but mainly anti-aligned with Earth's field, with peaks of -5 and +4nT observed, with a more neutral variation at times.
Geomagnetic activity was Quiet to Active, peaking with a Kp 4 in the 10/2100-2400 UTC interval.

Energetic Particles / Solar Radiation: The high energy proton flux (greater than 10 MeV) as measured at GOES16, has been at Background levels.
High energy electron flux (greater than 2MeV) has been at Moderate to High levels, peaking at 3330pfu at 09/1715UTC. The associated 24-hour fluence has been above the Active (1e8 integrated pfu) threshold throughout. The 10/0900UTC observation was 1.23e8 integrated pfu.

Four-Day Space Weather Forecast Summary
Solar Activity: Solar activity is forecast to be Low to Moderate initially. This looks to reduce somewhat into the period as current sunspots look to simplify slightly, but with Moderate still

Issued by Met Office Space Weather Advisor, Tel: +44 (0) 330 135 4254 Email: moswoc@metoffice.gov.uk

© Crown Copyright 2022. All Rights Reserved.

possible particularly as one or more active regions likely rotates over the eastern limb onto the visible disk. The degree to which this new areas manifests will be determined as and when any regions arrive. None of the more noteworthy groups on the disc leave the western limb in the next four days.

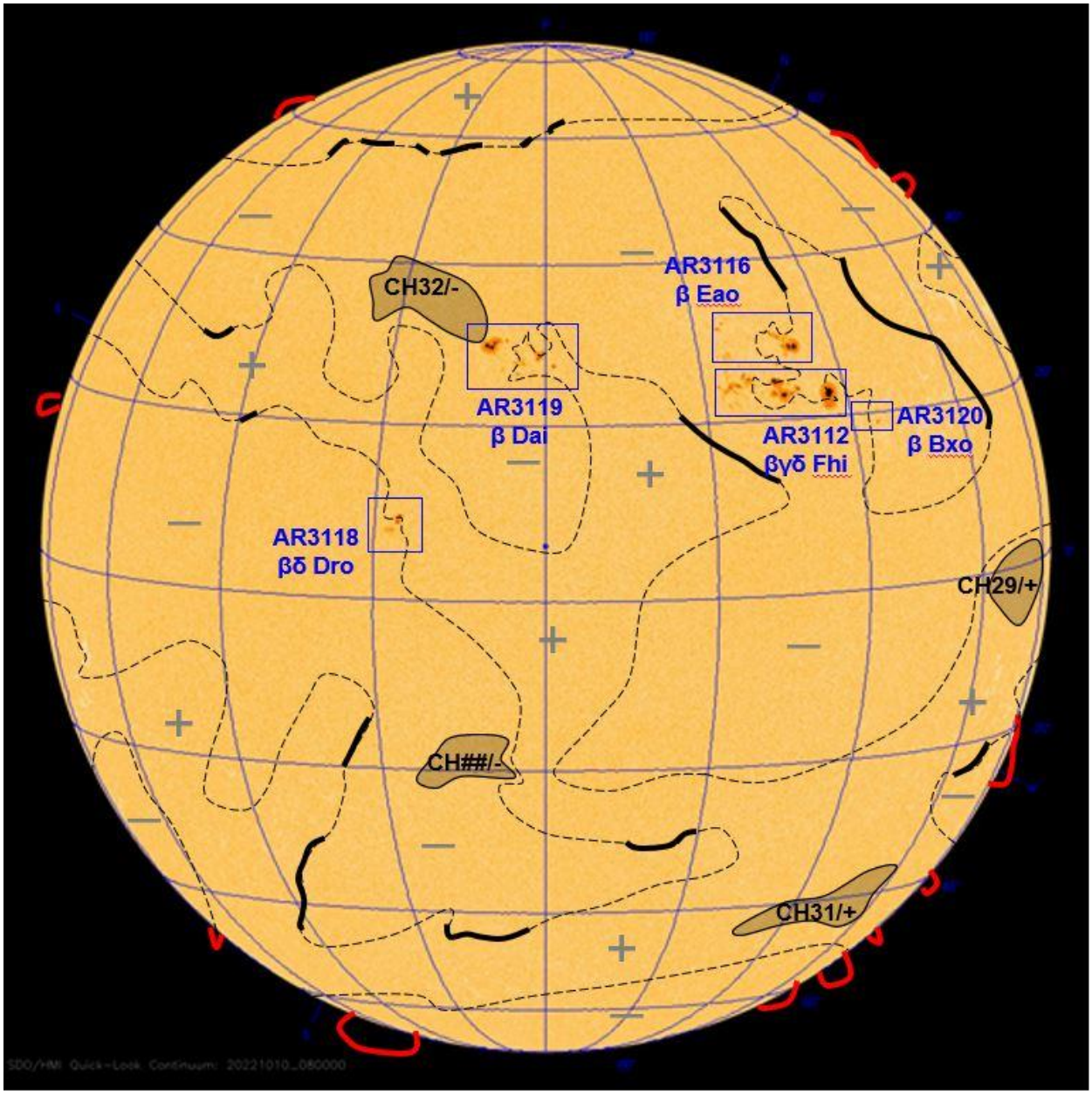
Solar Wind / Geomagnetic Activity: There are no major Earth-directed CMEs in the forecast, however the 07/0730UTC filament eruption CME may pass close to the Earth overnight UTC 11 into 12 October, giving some very slight peripheral influences. The 09/2300 UTC filament eruption from the southeast quadrant has been analysed as having the potential for an Earth directed component, with provisional assessment giving the risk of a glancing hit early on the 14th.
Otherwise, ongoing fast winds, most probably from CH29/+ and perhaps CH31/+, are likely to gradually ease through the start of the period, likely approaching background by midweek UTC (12 October). Some enhancement is possible at times due to possible glancing CME effects. Largely Quiet to Unsettled but with a risk of Active intervals day 1 in association with ongoing HSS activity and later in the period in association with possible glancing CME impacts.

Energetic Particles / Solar Radiation: The high energy proton flux (greater than 10MeV) is expected to be at Background, but with a daily Slight Chance of rising in response to any large flares, primarily from AR3112 or AR3116 in the northwest disc.
The high energy electron flux (greater than 2 MeV) is likely to persist at mainly Moderate to High levels. The associated electron fluence is forecast to persist at Active levels, but with confidence declining later in the period.

Issued by Met Office Space Weather Advisor, Tel: +44 (0) 330 135 4254 Email: moswoc@metoffice.gov.uk

© Crown Copyright 2022. All Rights Reserved.

Figure 1. Solar Analysis Valid 10/0800 UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

Issued by Met Office Space Weather Advisor, Tel: +44 (0) 330 135 4254 Email: moswoc@metoffice.gov.uk

© Crown Copyright 2022. All Rights Reserved.

Geomagnetic Storms:

There are no major Earth-directed CMEs in the forecast, however the 07/0730UTC filament eruption CME may pass close to the Earth overnight UTC 11 into 12 October, giving some very slight peripheral influences. The 09/2300 UTC filament eruption from the southeast quadrant has been analysed as having the potential for an Earth directed component, with provisional assessment giving the risk of a glancing hit early on the 14th.

Otherwise, ongoing fast winds, most probably from CH29/+ and perhaps CH31/+, are likely to gradually ease through the start of the period, likely approaching background by midweek UTC (12 October). Some further enhancement is possible at times due to possible glancing CME effects, although both CMEs are slow and weak and likely to give only minor effects.
Largely Quiet to Unsettled, but with a risk of Active intervals on Day 1 (10 Oct) in association with ongoing HSS activity and later in the period in association with possible glancing CME impacts.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	10	5	5	1
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

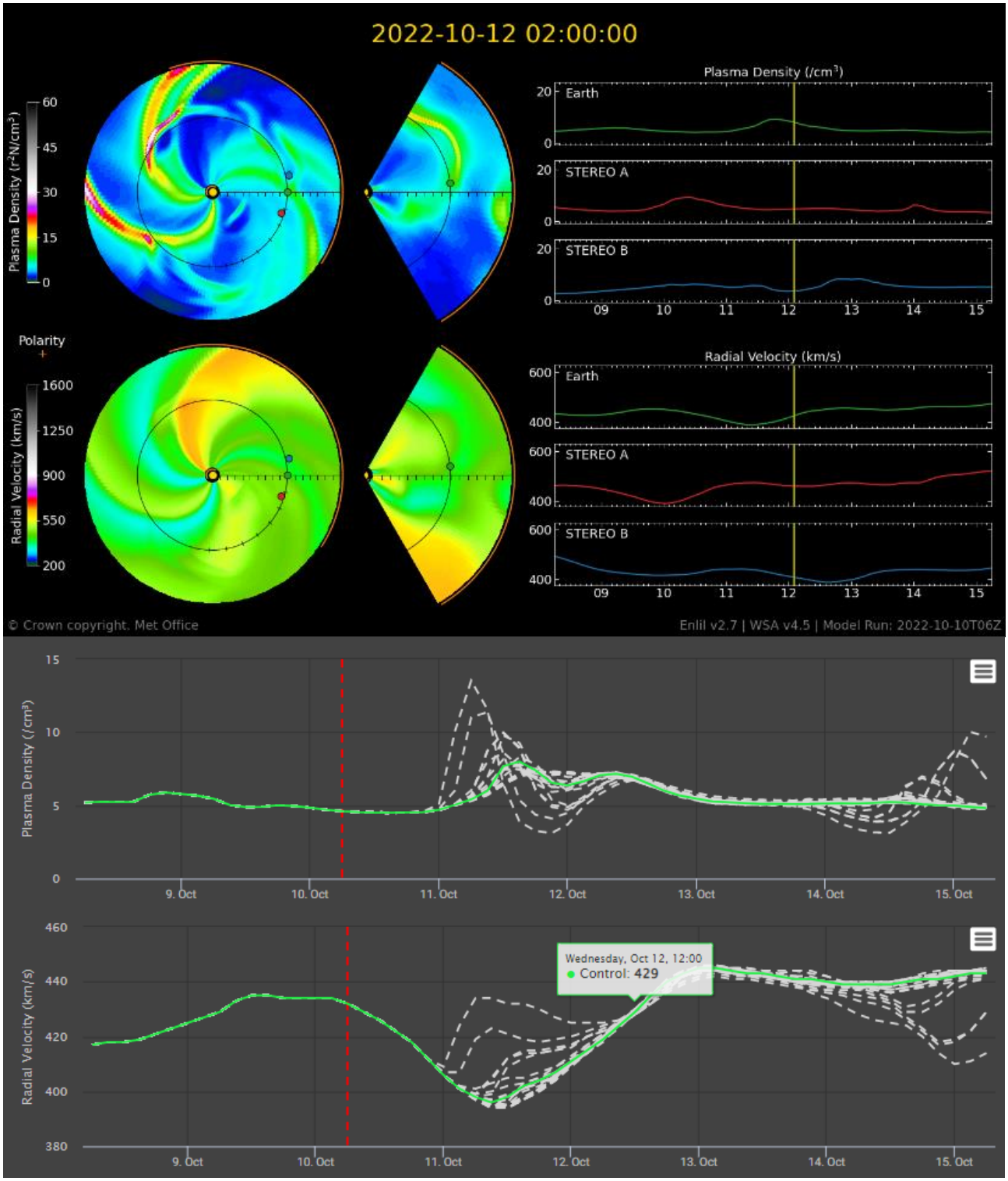
Geomagnetic Activity - Earthbound Coronal Mass Ejections

Date/time 21.5R (UTC)	Halo: Full or Partial	Source	Source Location	Estimated Speed	Estimated Arrival Time	Comments
*	*	*	*	*	*	*

Issued by Met Office Space Weather Advisor, Tel: +44 (0) 330 135 4254 Email: moswoc@metoffice.gov.uk

© Crown Copyright 2022. All Rights Reserved.

Figure 2: Enlil and ensemble showing possible glancing blows later on 11 Oct or early on 12 Oct, and again on 14 Oct.



Issued by Met Office Space Weather Advisor, Tel: +44 (0) 330 135 4254 Email: moswoc@metoffice.gov.uk

© Crown Copyright 2022. All Rights Reserved.

Radio Blackouts - X-Ray Flares:

There are now five sunspot regions on the disc, and the these should remain on the Earth-facing side regardless of the fates of these spots in terms of development or decay over the four days. Far-side soundings suggest that there may be a succession of large regions due over the eastern solar horizon through the course of the coming UTC working week, with this implying a possible increase in the risk of flares, although this will be confirmed as and when they present over the eastern limb for analysis.

There is therefore a flat trend in flare risk at present, with AR3112 dominating, although the risk has been revised downwards significantly from raw values arising from historical precedents. Reasons for doing so include AR3112's penchant for small long-period flares; its age; its lack of shear for mostly lying at one (extended) solar latitude. It is showing signs of losing delta spots however. AR3118 has also shown development of a small delta spot and will need monitoring.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	No	50	50	50	50
Very Active	R3 to R5 X Class	No	5	5	5	5

Solar Radiation Storms - (High Energy Protons):

The high energy proton flux (greater than 10MeV) as observed by GOES16 is currently at Background levels.
While there has yet to be any notable flaring from AR3112 and AR3116 in particular, their westward advance and nominal complexity mean that there is a residual slightly rising chance of S1, although the rise is too slight to represent in the probability tables. Any arriving eastern horizon regions are thought unlikely to contribute for some time yet to this risk.

Radiation Storms	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ S1	No	5	5	5	5
Very Active	≥ S3 *	No	1	1	1	1

* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)

Issued by Met Office Space Weather Advisor, Tel: +44 (0) 330 135 4254 Email: moswoc@metoffice.gov.uk

© Crown Copyright 2022. All Rights Reserved.

High Energy Electrons Event (≥ 2MeV):

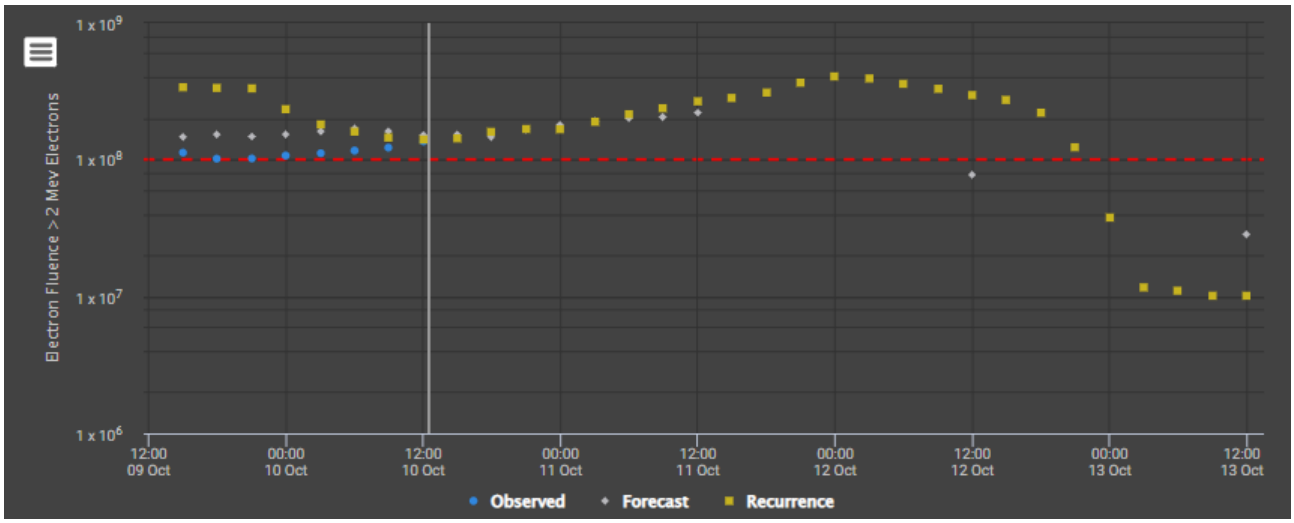
The high energy (greater than 2MeV) electron flux as observed by GOES16 is currently High, despite recent minor geomagnetic activity, and is likely to stay that way through the coming days. Glancing CME effects are possible through this period, which may give a reduction in flux however.

Fluence is currently just above Active (1e8 integrated pfu). Given that the threat of significant geomagnetic activity is greatest earlier on in the four-day forecast period (from the incumbent fast wind from CH29), the chances of the current diurnal oscillation being disturbed or re-set at lower flux levels is highest to start the working week. Should this not occur, fluence is likely to remain Active, although with decreasing confidence in the coming days.

Overall, Active fluence is considered 'odds on' throughout, although this is only slightly better than 'evens' beyond the immediate term for reasons described above.

GEO Electron Environment Probability (Exceedance)	Level ($cm^{-2}\,sr^{-1}\,day^{-1}$)	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ $1x10^8$**	Yes	100	80	60	60
Very Active	**≥ 2 MeV ≥ $1x10^9$**	No	1	1	1	1

Figure 3: REFM showing a slight declining trend, this may be more likely to continue above the Active threshold.



Issued by Met Office Space Weather Advisor, Tel: +44 (0) 330 135 4254 Email: moswoc@metoffice.gov.uk

© Crown Copyright 2022. All Rights Reserved.